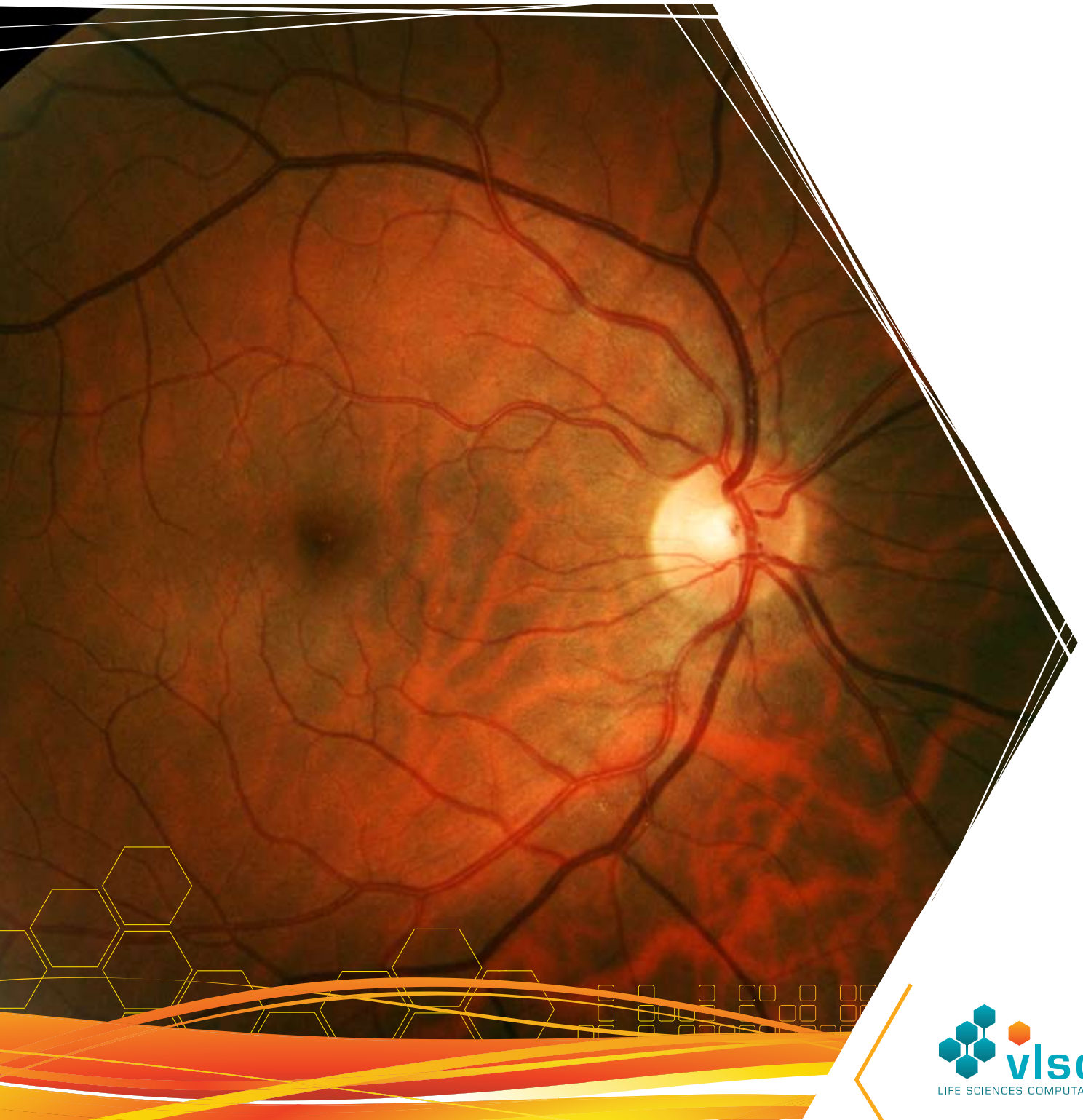
A BETTER WAY TO DIAGNOSE GLAUCOMA

Computer scientist Dr Andrew Turpin and optometry researcher Dr Allison McKendrick are using a supercomputer to try to reduce from years to months the time taken to diagnose the worsening of vision which signifies glaucoma, the world's second most common cause of irreversible blindness.

Tim Thwaites, Science Writer



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"Making things much more realistic"

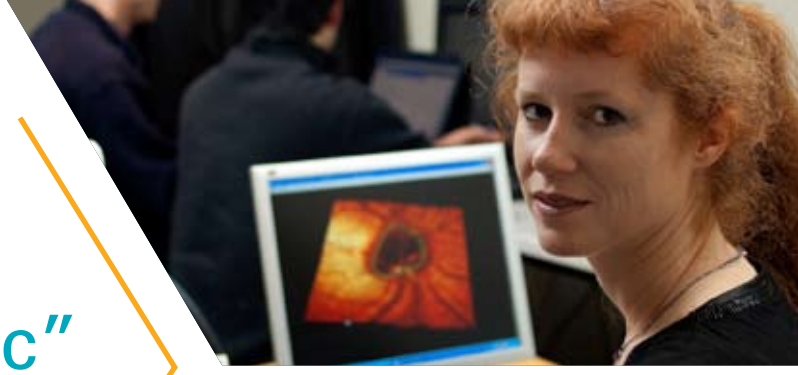
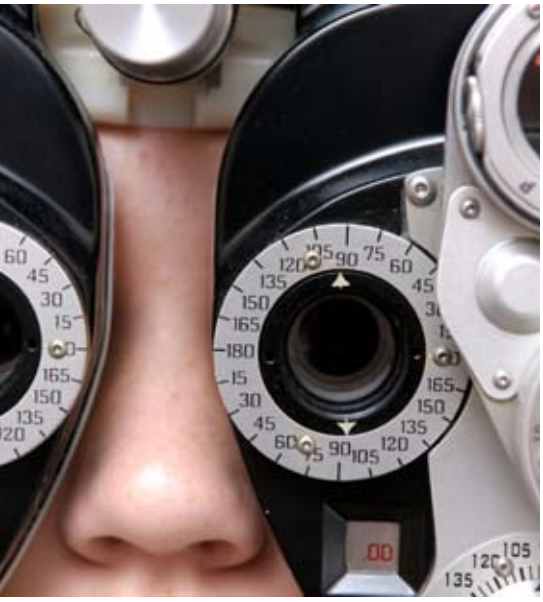


Image credit: David Paul

Already, they have published studies on ways to increase the efficiency of testing for glaucoma, the deterioration of the optic nerve. But now, using the more powerful and sophisticated facilities available through the Victorian Life Science Computation Initiative (VLSCI), they hope to go much further—providing not only faster, but also more accurate and more realistic diagnoses. And eventually they plan to model the millions of cells which comprise the optic nerve itself.

At present, there are two main diagnostic tools for glaucoma. One is to study images of the optic nerve head—an area at the back of the eye through which all the optic nerve cell fibres pass on their way from the retina to the brain—in order to detect anatomical damage.



The second is less direct—measuring the extent of the visual field by asking patients to press a button when they become aware of a flashing light. Deterioration of peripheral vision is an early sign of glaucoma. Readings of fluid pressure in the eye are also typically taken, because pressure on the nerve increases the risk of glaucoma.

"The images are hard to interpret," Andrew says. "Normally, there is considerable variability between people in the appearance of the optic nerve. So, detecting changes due to disease demands careful monitoring over time. But there are also problems with visual field testing. People make mistakes. Testing can take 20 minutes and attention wanes. Often, the test needs to be repeated every six months for three or four years before it is clear whether vision is deteriorating."

Andrew and Allison have been working at improving visual field testing by determining the optimum timing, position and intensity of the lights presented, as well as coming up with more efficient algorithms to manage and analyse testing. They are also studying how imaging and visual field data can be integrated and used to focus testing better. The work demands extensive, rigorous and repetitive testing.

"One day a reviewer of one of our papers commented that 1000 repeats of one test, which had taken us a month to do, was not accurate enough," says Andrew. "We needed something like 100,000 repeats." That was a turning point. Andrew registered as a remote user of an IBM Blue Gene supercomputer at its Watson Research Laboratory north of New York City, and was able to complete 100,000 simulations in a day.

But access to a supercomputer did not just provide a means of speeding up research, it also opened many new possibilities. "We can now step into more computationally intensive algorithms," Andrew says. "The existing testing machines use many simplifying assumptions. We can now begin to design the next generation of algorithms and gradually remove those assumptions, making things much more realistic."

The supercomputer also opens the way to constructing a model of how nerve cells grow in the eye. With that sort of knowledge the researchers hope to develop the ability to gather information from images which will allow them to predict what people can see. "We are only just starting out on that," says Andrew.

The advent of the VLSCI is important to the research. A Blue Gene supercomputer in Melbourne will get around the slow speed of sending jobs to New York, and finding slots throughout the day and night when the American machine is available. Andrew says he had not counted on the fact that geeks do not sleep—the US machine is booked out 24/7.

On the basis of their past published work, the pair have already begun talking to manufacturers of visual field testing equipment with a view to upgrading their devices. "We are keen to get our ideas out into the clinic," Andrew says.

For further information about this research contact Andrew Turpin at aturpin@unimelb.edu.au.

To contact VLSCI, go to www.vlsci.org.au

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VLSCI is an initiative of the Victorian Government in partnership with The University of Melbourne and the IBM Research Collaboratory for Life Sciences, Melbourne. It exists for all Victorian researchers and aims to be one of the top five life science computation facilities in the world by 2013.